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The effect of collaborative care on the progression of diabetic complications in patients with Type II Diabetes Mellitus: A systematic review

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ABSTRACT

Background: Type II diabetes significantly affects people worldwide, considerably contributing to the global health burden due to factors such as lifestyle habits, dietary practices, physical inactivity, and genetic factors. **Objective:** The systematic review evaluates the effectiveness of collaborative care methods for the management of Type II Diabetes Mellitus as well as its associated comorbidities, highlighting the importance of multidisciplinary healthcare providers in improving the quality of life of patients. **Methodology:** The study investigators conducted a systematic review using various search engines to find research studies focused on interventions. An extensive search was conducted using one or more of the following online databases: Medline, Google Scholar, PubMed, Scopus, Embase, PsycINFO, and CINAHL. The study group conducted a systematic review following the established principles set forth by the PRISMA guidelines. **Results:** The review included recent studies conducted between 2003 and 2024. The current study included 20 research articles that met the predetermined criteria, selected from 16,852 studies. Collaborative interventions among healthcare professionals—such as physicians, pharmacists, nurses, and nutritionists—led to substantial reductions in HbA1C levels, decreased diastolic and systolic blood pressure, and improved lipid profiles. We used the ZEE tool to evaluate the quality and relevance of the research. **Conclusion:** The review shows the beneficial effects of the collaborative care framework and underlines the importance of bringing together multiple disciplines in providing patient education. Healthcare professionals, such as doctors, nurse practitioners, pharmacists, and nutritionists, have a vital role in offering individualized counselling tailored to each patient's specific needs. This customized approach

enhances the treatment of Type II Diabetes Mellitus and decreases the likelihood of related complications.

Keywords: Type II Diabetes Mellitus, complications of diabetes, retinopathy, nephropathy, neuropathy, collaborative care, multidisciplinary care.

1. INTRODUCTION

Type II diabetes mellitus is a chronic metabolic disorder characterized by elevated glucose concentration in the bloodstream. It is the result of either the body's resistance to insulin or insufficient insulin generation (Baynes, 2015). In 2019, the International Diabetes Federation documented over 463 million individuals globally who had diabetes. Experts anticipate that this number will rise to 700 million by the year 2045 (Deshmukh et al., 2015). Type II diabetes is the predominant variant, comprising approximately 90% of every single case of diabetes. Type I diabetes is relatively uncommon and typically manifests in children and young people (Alam et al., 2021). The rising worldwide prevalence of type II diabetes mellitus poses a significant burden on the healthcare system and has profound implications for patients' overall quality of life in the year 2045 (Williams et al., 2012).

Diabetes is a chronic medical condition that affects blood sugar levels and leads to many complications, including heart disease, peripheral neuropathy, nephropathy, and retinopathy (Iqbal et al., 2021a). Annually, global expenditures for controlling diabetes mellitus (DM) total approximately USD 760 billion. In 2019, diabetes mellitus (DM) and its consequences caused 4.2 million fatalities, which is comparable to one death occurring every eight seconds. Among these deaths, 46.2% were those under the age of 60, who belong to the working age group. These complications adversely affect patient's health and lead to increased healthcare costs (Tomic et al., 2022). Specifically, cardiovascular disease is a leading cause of mortality as well as morbidity in those with type 2 diabetes mellitus (Cai et al., 2020). Collaborative care, an integrative approach that engages multidisciplinary healthcare teams, is increasingly recognized as an effective strategy for treating chronic illnesses. These include hypertension, diabetes mellitus, osteoporosis, depression and anxiety, asthma, and COPD (Shahid et al., 2024).

Interdisciplinary collaborative care often involves the teamwork of two or more healthcare professionals working together with patients and their caretakers to achieve a common goal. This approach aims to provide well-coordinated, high-quality treatment centred on the patient's needs within and across various healthcare settings (Naylor et al., 2010). Multidisciplinary care for type II diabetes involves coordinated efforts from physicians, pharmacists, dietitians, physical therapists, nurses, and psychologists to provide comprehensive management of the disease (Johnson and Carragher, 2018; Madden et al., 2013; Gucciardi et al., 2016). Collaborative care intends to optimal patient outcomes, increase patient satisfaction, and decrease healthcare expenses by assuring coordinated and integrated care across multiple disciplines (Pelone et al., 2017). Compared to the traditional physician-centered treatment model, initiatives using a multidisciplinary collaborative care approach have demonstrated reduced average glycated hemoglobin (HbA1c) levels ranging from 0.20% to 1.60% (Tjam et al., 2006; Litaker et al., 2003).

It is important to note that the systematic review analyzed multiple studies which investigated the effectiveness of collaborative care in treating type 2 diabetes mellitus (Siaw and Lee, 2019). There is still a gap in the current literature about the precise impact of collaborative care on the progression of complications associated with diabetes. This observation underscores the need for a focused review to understand better and potentially enhance long-term results for individuals with type 2 diabetes by utilizing collaborative care approaches. This review article aims to systematically assess how collaborative care influences the progression of diabetic complications in patients with Type II Diabetes Mellitus.

2. MATERIAL & METHODS

Following the PRISMA standards, we conducted a comprehensive literature search utilizing various databases, including Google Scholar, Medline, PubMed, SCOPUS, Embase, PsycINFO, and CINAHL. The majority of the articles in the search were in the English language and comprised cohort, case-control, and randomized, controlled trials (RCTs). It encompassed three key themes: (a) Type 2 Diabetes Mellitus, (b) Collaborative Care, and (c) Diabetes complications. The terminology used to define team-based care included terms such as "collaborative care", "coordinated care", "interdisciplinary care", "integrated care", and "multidisciplinary care". For diabetic complications, we used terms such as "Nephropathy", "Retinopathy", "Cardiovascular complications", "Neurological

complications", and "Dermatological complications". The search covered studies conducted between 2003 and 2024. We discovered 16,852 studies and selected only 20 for the systematic review based on their strict adherence to the inclusion criteria.

Inclusion Criteria

Randomized, controlled trials (RCTs), cohort studies, and case-controlled studies. Longitudinal studies with a follow-up period of at least six months.

The participants consisted of persons aged 18 or older who have been diagnosed with type II diabetes mellitus.

Studies involving collaborative care interventions may include a multidisciplinary healthcare team consisting of physicians, nurses, dietitians, psychologists, and other relevant healthcare professionals.

Interventions cover several strategies, such as educating patients, providing support for self-management, managing medications, making lifestyle changes, and employing collaborative methods.

The objective is to analyze the development of type II diabetes mellitus, with a specific emphasis on effectively regulating blood sugar levels as shown by HbA1c levels, and resolving any related complications.

Additionally, the evaluation will consider the impact on quality of life and other important clinical outcomes.

Exclusion Criteria

Exclusions include case reports, letters, editorials, and conference abstracts.

Studies were removed due to insufficient follow-up durations, namely those that were shorter than six months.

Research involving individuals below the age of 18 years was not included.

Research primarily focused on populations with different forms of diabetes, such as type I diabetes.

Studies evaluating interventions that are not considered collaborative care or do not involve a multidisciplinary team.

Studies lacking relevant outcome measures related to the progression of type II diabetes mellitus.

Study Design

Data Extraction

These studies gathered data on various aspects, including the authors, the location of the research, the year in which the study was conducted, the number of participants or the population studied, the structure of the study, the interventions implemented during the experiment, and the effects of these interventions on participants' HbA1C levels. The ZEE tool serves as a list of criteria for assessing the scientific quality of the included studies.

Data Synthesis and Analysis

Our focus was primarily on understanding the role of healthcare professionals in managing diabetes and its associated complications. The result was achieved through a comprehensive analysis of treatment methods used in the research study and monitoring their impact on HbA1C levels, diastolic and systolic blood pressure and serum lipid profiles. The findings and subsequent discussions emphasized the beneficial effects of collaborative care in managing Type II Diabetes Mellitus.

3. RESULTS

By conducting searches in electronic databases, we identified 16852 original research publications. After eliminating duplicate and inappropriate records, we screened 11,292 articles. We removed 30 publications that were published over 20 years ago. Additionally, we omitted 1,072 articles after reviewing their titles and keywords and we were left with 190 studies for further evaluation. We attempted to locate 190 of these studies. Following the abstract and full-text screening, we rejected 170 publications. Only 20 studies met the inclusion criteria. Ultimately, we selected 20 research publications for inclusion in the review. To obtain comprehensive information on data extraction, please consult the PRISMA Chart illustrated in (Figure 1). A significant number of the studies reviewed featured sufficient sample sizes and effective study designs. They produced well-defined and consistent results. Moreover, every study incorporated in our systematic review revealed no conflicts of interest.

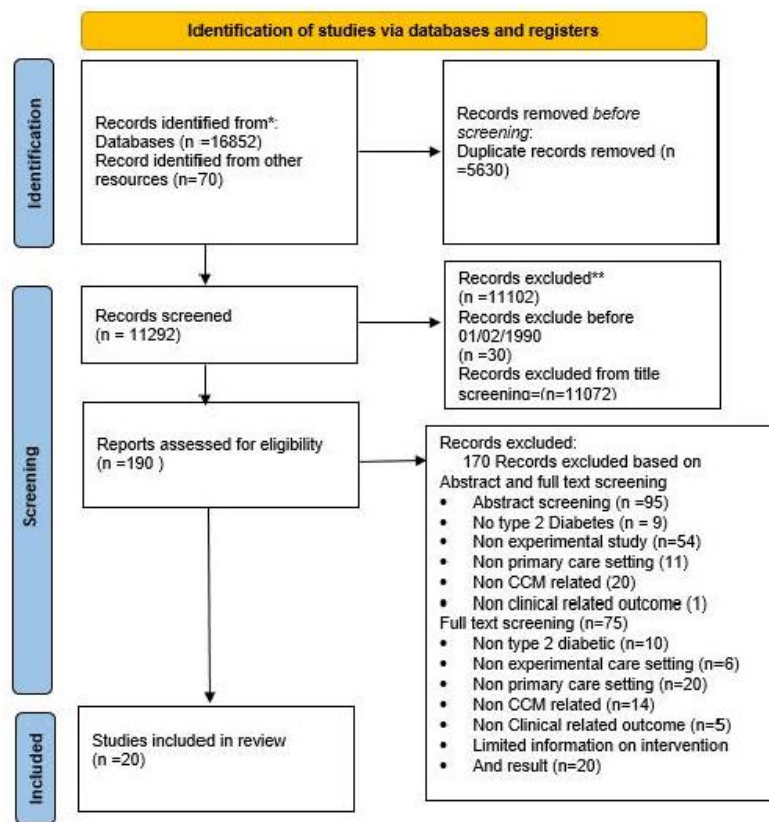


Figure 1 Represents the PRISMA flow chart of the systematic review.

Characteristics of the study

The specific information required includes details about the authors and the country where the research took place, the study design, the duration of data collection, the sampling procedure used, the sample size, the number of follow-ups, and the types of interventions given, as well as the outcomes achieved. Altogether, we included 20 studies. Most of these, five in total, were from Malaysia, underscoring a Southeast Asian perspective. The rest included one study from England, Spain, Canada, Pakistan, Jordan, Australia, Singapore, Mexico, Northern Cyprus, Lebanon, Nigeria, Brazil, India, and China, incorporating a global spectrum of experiences and interventions. Most of these were randomized control trials. The research primarily examines three fundamental types of interventions: Educational, nutritional, and lifestyle.

Multiple studies have demonstrated that dietary therapies, physical activity, and lifestyle adjustments can effectively reduce fasting blood glucose levels and HbA1c, essential markers of controlling blood sugar in patients with diabetes. Furthermore, these lifestyle modifications helped lower both systolic and diastolic blood pressure, as well as reduce LDL cholesterol and total cholesterol levels. These modifications improve potential risk factors associated with cardiovascular disorders linked to Type II Diabetes Mellitus. The nurses' intervention, which encompassed dietary modification, health education, adherence to medication, and strategies for managing diabetes, led to a substantial improvement in HbA1C levels and better maintenance of glucose levels in the blood in patients with diabetes.

The research findings have also shown that in-person pharmacist counseling is critically important for managing Type II Diabetes Mellitus and its complications. Pharmacists, through their expertise in medication management, patient education, and lifestyle modifications enhance glycemic control, promote patient adherence to medications and treatment plans, and decrease the likelihood of complications such as cardiovascular disease, nephropathy, and diabetic retinopathy. Research has shown that collaborative efforts between pharmacists and physicians improve medication adherence, glycemic control, and patient education. Moreover, collaborative care has proven effective in treating and preventing diabetes-related complications, including cardiovascular issues, peripheral vascular problems, nephropathy, and retinopathy.

Psychiatrists work together with a range of healthcare professionals, such as primary care physicians, diabetes specialists, dietitians, nutritionists, and pharmacists, to assist patients in dealing with the emotional and psychological difficulties that come with living with a long-term condition like Type II diabetes. The objective of this joint effort is to improve the overall well-being of patients. The approach of collaborative care has demonstrated efficacy in the prevention and management of problems linked to Type II Diabetes Mellitus. A collaborative group of healthcare providers can provide complete and holistic treatment to persons diagnosed with Type II Diabetes. As a result, this collaborative approach can effectively minimize the progression of complications associated with Type II diabetes mellitus

ZEE Tool

Assessing the methodological quality and potential for bias in research is a crucial step researcher must take before conducting the studies. We used the ZEE assessment tool. We applied the tool to various study designs, including randomized controlled trials, cohort studies, and case-controlled studies. The results of the assessments showed that study #1 scored 15, study #2 scored 14, study #3 scored 13, study #4 scored 14, study #5 scored 13, study #6 scored 17, study #7 scored 14, study #8 scored 17, study #9 scored 16, study #10 scored 14, study #11 scored 16, study #12 scored 16, study #13 scored 16, study #14 scored 16, study #15 scored 15, study #16 scored 18, study #17 scored 18, study #18 scored 15, study #19 scored 17, study #20 scored 16. Overall, applying ZEE tool in Table 1, facilitated a comprehensive assessment of methodological quality, enhancing the reliability and validity of the research findings. For more details refer to (Table 1). On the other hand, Table 2 represents the study characteristics of the included studies. For more information can refer to (Table 2).

Table 1 Represents the ZEE tool

Study 20 (Wang et al., 2022)	✓	✓	✓
Study 19 (Ali et al., 2020)	✓	✓	✓
Study 18 (Moifar et al., 2016)	✓	✓	✓
Study 17 (Iqbal et al., 2024)	✓	✓	✓
Study 16 (Aguiar et al., 2018)	✓	✓	✓
Study 15 (Ayeni et al., 2021)	✓	✓	✗
Study 14 (Khan et al., 2021b)	✓	✓	✗
Study 13 (Khan et al., 2021)	✓	✓	✓
Study 12 (Khan et al., 2021a)	✓	✓	✓
Study 11 (Iqbal et al., 2021)	✓	✓	✓
Study 10 (Mouhtadi et al., 2018)	✓	✓	✗
Study 9 (Korcegez et al., 2017)	✓	✓	✗
Study 8 (Ganiochipi et al., 2016)	✓	✓	✓
Study 7 (Nazir et al., 2016)	✓	✓	✓
Study 6 (Boyle et al., 2016)	✓	✓	✓
Study 5 (Wishah et al., 2015)	✓	✓	✓
Study 4 (Samtia et al., 2013)	✓	✓	✓
Study 3 (Cardenas-Valladolid et al., 2012)	✓	✓	✓
Study 2 (Salas-Salvadó et al., 2011)	✓	✓	✓
Study 1 (Gaede et al., 2003)	✓	✓	✓

Design for Stated Aim(s)																			
Definition of Target/Reference Population	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Appropriateness of Sample Frame	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Likelihood of Representative Selection Process	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Measures Addressing Non-Responders	✗	✗	✗	✗	✗	✓	✗	✓	✓	✗	✓	✗	✗	✓	✗	✓	✓	✗	✓
Appropriateness of Risk Factor and Variable Measures	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Accuracy of Risk Factor and Outcome Variable Measurement	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Clarity of Statistical Significance and Precision Estimation Methods	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sufficiency of Method Description	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

n for Reproduci bility																			
Adequacy of Basic Data Descriptio n	✓	✓	✗	✗	✗	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Concerns Regarding Non- Response Bias	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Descriptio n of Non- Responder s, if Applicable	✗	✗	✗	✗	✗	✓	✗	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✓
Internal Consistenc y of Results	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Presentatio n of Results Correspon ding to Methodolo gical Descriptio n	✓	✓	✓	✓	✗	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓
Justificatio n of Author's Discussion s and Conclusion s by Results	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Discussion of Study Limitations	✓	✗	✗	✗	✗	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓	✓	✓
Disclosure of Funding Sources and	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗

Conflicts of Interest																				
Attainment of Ethical Approval and Participant Consent	x	x	x	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	x	✓

Table 2 Represents the study characteristics of the included studies

Sr#	Study	Year	Country	Study Design	Sample Size	Follow-ups	Intervention	Outcome
1.	(Gaede et al., 2003)	2003	England	Parallel Trial	N=80	Every third month	The dietary interventions included: 1. Patients were encouraged to avoid excessive saturated fat in daily diet. 2. The recommendation was for patients to participate in moderate exercise for at least 30 minutes per week. 3. Patients were given pills or insulin if they couldn't keep blood sugar levels in check.	Researchers noted considerable variations in the levels of fasting plasma glucose, glycosylated hemoglobin, fasting serum lipids, systolic and diastolic blood pressure, and the rate of urine albumin excretion.
2.	(Salas-Salvadó et al., 2011)	2011	Spain	Multi-center randomized control trial	N=418	After four years	The study based its intervention on a Mediterranean diet unrestricted in calories and enhanced with either virgin olive oil or mixed nuts and compared it to a control group that received guidance on a low-fat diet. The intervention significantly reduced the likelihood of developing diabetes by 52%.	The Mediterranean diet is quite beneficial for patients diagnosed with Type II Diabetes, who have a greater chance of cardiovascular complications.

3.	(Cardenas-Valladolid et al., 2012)	2012	Canada	A two-year prospective follow-up study	N=24124	Two-year prospective follow-up	Nursing intervention aimed to improve Drug therapy compliance, lifestyle modification, health education, control of blood sugar levels, controlling cardiovascular risk factors and self-management	A higher percentage of patients with a baseline HbA1c level of 7 or above experienced a drop to less than 7% at the two-year follow-up.
4.	(Samtia et al., 2013)	2013	Pakistan	Questionnaire based	Control group n=170 intervention group=178	After every four weeks for three months	The intervention group received predetermined care that included education on their disease, medication effects, the role of exercise, self-monitoring, smoking cessation, and other topics.	The intervention group demonstrated a significant decrease in fasting blood glucose levels compared to control group. The HbA1c level of the intervention group decreased by 19.26mg/dl.
5.	(Wishah et al., 2015)	2015	Jordan	Randomized Control Trial	N=106	At three-month and six-month intervals	The clinical research involved pharmacist-initiated drug therapy or drug dose titration, conducted in collaboration with a physician, to adhere to the type 2 diabetes management guidelines	After six months of follow-up, the patients who received the intervention experienced an average reduction in HbA1c of 1.7% compared to a decrease of 0.3% in the control group.
6.	(Boyle et al., 2016)	2016	Australia	Qualitative interpretive.	N=10	No follow up	The additional time spent with the general practice nurse to clinically evaluate type II diabetes benefits overall patient care.	According to the study, general practitioner nurses' involvement in type II diabetes management is essential for

								successful patient handling.
7.	(Xu et al., 2022)	2022	Singapore	A multicenter randomized controlled trial	N=255	After twelve-month period	The intervention group received collaborative care that included education on their disease, medication adherence, lifestyle modification, and exercise.	Over a 12 months' period, the intervention group demonstrated a more significant reduction in both glycated hemoglobin (HbA1c) and quality-adjusted life years (QALY). Over for a year, the expenses per extra HbA1c and QALY improvement were \$40.52 and \$920.91, respectively.
8.	(Gamiochipi et al., 2016)	2016	Mexico	A controlled clinical trial using two parallel groups employed a double-blind method of evaluation.	N=199	After six months	The team provided the patients with an intervention in lifestyle and physical activity.	The intensive intervention significantly lowered both weight and HbA1c values.
9.	(Korcegez et al., 2017)	2017	Northern Cyprus	Randomized control trial	N=152	Five in-person training sessions extend over an entire year	In the study, the intervention group had five scheduled face-to-face meetings with a clinical pharmacist at three-month intervals, timed to coincide with their physician appointments. At these meetings, the pharmacist educated the patients on tracking their blood glucose, managing	The intervention group exhibited lower HbA1c values, with a reduction of 0.74 compared to 0.04 in the control group. However, the intervention and control groups showed reduced fasting blood glucose levels.

							their diet, exercising, and avoiding tobacco use. Additionally, the pharmacist distributed informative pamphlets on diabetes management and prompted patients to bring their medications to each meeting.	
10.	(Mouhtadi et al., 2018)	2018	Lebanon	Pilot Study	N=200	Once every month for twelve months	Participants were referred to community pharmacies by their primary care providers for monthly 30-minute counseling sessions. These sessions, led by pharmacists, included completing a questionnaire and receiving structured guidance on their illness and medication over a 12 months period.	At baseline, the mean fasting blood glucose (FBG) level was 155 mg/dl, which dropped considerably to 125 mg/dl. From a baseline value of $7.5\% \pm 1.4\%$, the HbA1c level decreased to $6.8\% \pm 0.9\%$.
11.	(Iqbal et al., 2021a)	2021	Malaysia	Randomized Control Trial	N=400	Two follow up visits for both groups in one year	The intervention group received standard hospital treatment plus additional pharmacist counseling sessions from the Diabetes Medication Therapy Adherence Clinic departments. In contrast, the control group received only the usual hospital care.	The mean HbA1c (hemoglobin A1c) levels decreased by 1.43% in the control group and 2.82% in the intervention group. The intervention group experienced a considerable reduction in HbA1c compared to the control group.

12.	(Khan et al., 2021b)	2021	Malaysia	Randomized Control Trial	N=400	Four follow ups in one year	The intervention group received standard hospital treatment plus additional pharmacist counseling sessions.	The mean HbA1c levels in the control group exhibited a reduction of 1.96% and 3.41% in the intervention group compared to the initial data.
13.	(Iqbal et al., 2021)	2021	Malaysia	Randomized Control Trial	N=400	Total four follow-ups each after every three months	Patients in the intervention group received additional counselling sessions with pharmacists and the standard therapy.	After one year, the intervention group showed statistically significant improvements in the signs and symptoms of diabetic nephropathy. Additionally, this group experienced a dramatic reduction in the incidence of diabetic nephropathy.
14.	(Khan et al., 2021a)	2021	Malaysia	Randomized Control Trial	N=400	Total four follow-ups each after every three months	The intervention included Pharmacist counseling sessions under the Diabetes Medication Therapy Adherence Clinic program (DMTAC) and usual care.	The intervention group exhibited a significant reduction in the signs and symptoms of diabetic foot as compared to the control group.
15.	(Ayeni et al., 2021)	2021	Nigeria	quasi-experimental study	N=52	Monthly follow-ups for six months	The pharmacist's intervention included monitoring for adverse drug effects, resolving drug-related problems, measuring HbA1c levels, conducting	The study showed that treatments administered by a clinical pharmacist led to reductions in fasting blood

							monthly fasting blood glucose tests, and managing diabetes following international diagnostic standards.	sugar levels and improved the likelihood of achieving successful treatment outcomes and cure rates while also minimizing adverse effects.
16.	(Aguilar et al., 2018)	2018	Brazil	Randomized Control Trial	N=80	Upto 12 months	The patients engaged in face-to-face consultations, with each session lasting between 20 and 40 minutes. In addition, patients received 1 or 2 phone calls remotely during the time period between follow-up consultations. We provided the patients with educational leaflets and a self-monitoring monthly diary. The clinical pharmacist also acknowledges the drug-related problems.	Due to the collaborative patient care provided by both the pharmacist and physician, reductions and control of HbA1C levels (<7%) have been observed. Hypertensive patients have exhibited decreased blood pressure readings (<130/80 mmHg), while patients with dyslipidemia have shown LDL cholesterol levels below 100 mg/dL.
17.	(Iqbal et al., 2024)	2024	Malaysia	A multi-centered randomized control trial	N=400	Two follow-ups after six-month interval	The pharmacist educated patient through Medication Therapy Adherence Clinics (DMTAC). The patients' clinical outcomes and laboratory data were evaluated and recorded on each visit.	The intervention group showed an impressive improvement in the clinical parameters compared to the control group.
18.	(Moinfar et	2016	Iran	Pre-post study	N=2757	After three	An expert team	The

	al., 2016)					months of intervention	effectively addressed both the psychological and metabolic disorders following evidence-based guidelines.	psychological intervention yielded no statistically significant improvements in glycemic and metabolic control. However, it did result in better blood pressure management. Additionally, patients who had previously faced challenges maintaining healthy blood sugar levels demonstrated notable enhancements in their average glycosylated hemoglobin (HbA1c) and fasting plasma glucose (FPG) levels.
19.	(Ali et al., 2020)	2020	India	A pragmatic randomized controlled trial conducted across multiple centers, using a parallel and open-label design	N=404	Follow-up after one year for two years.	The intervention group received one year of self-care assistance from non-physician care coordinators. They also received help with decisions through electronic medical records and specialist case reviews to aid physicians in adjusting treatment plans. Following the intervention period,	More patients in the intervention group achieved the main health goal of the study than those receiving usual care. While the study looked at multiple health outcomes, there were no significant differences for most of them after one and

							there was a 12-month observation period without further intervention.	two years between the two groups. Concerning serious health events like heart-related issues, strokes, deaths, and severe low blood sugar episodes, there were some occurrences in both groups.
20.	(Wang et al., 2022)	2022	China	Randomized Control Trial	N=72	Follow-up after every seven days	The research group adopted a cooperative nursing approach, which entailed providing information and guidance, enhancing self-care abilities, and promoting active engagement in the diagnostic and treatment process. In contrast, patients in the control group received standard nursing care, which primarily focused on advice regarding nutrition and exercise.	Following the intervention, the Research Group exhibited significantly reduced blood HbA1c and FPG levels compared to the Control Group.

4. DISCUSSION

Our extensive review of published literature on the impact of multidisciplinary treatment in managing Type II Diabetes Mellitus has led us to the significant conclusion that it appears beneficial in obtaining better glycemic control. Additionally, the study found improved medication adherence and higher quality of life scores. There was also a reduction in the frequency of diabetes-related complications. Upon reviewing the selected papers, it is evident that studies implementing a collaborative care strategy have shown a notable reduction in HbA1c levels. The collaborative care models often involve cooperation among many healthcare experts, including physicians, pharmacists, dietitians, and psychiatrists. Improving glycemic control is essential since it directly correlates with reducing the likelihood of chronic complications related to Type II Diabetes Mellitus, such as retinopathy, nephropathy, neuropathy, and cardiovascular disease.

Regardless of the degree of development of a nation, the standard of treatment for individuals with type II diabetes remains suboptimal (Abdulhadi et al., 2006). Age, heredity, race, and ethnicity are among the irreversible risk factors for type II diabetes

mellitus, while reversible risk variables include physical activity, diet, and smoking (Sami et al., 2017). Type II diabetes mellitus affects multiple systems in the body and necessitates treatment from various healthcare professionals who collaborate in a coordinated manner (Saint-Pierre et al., 2019). There is a belief that Multidisciplinary Teams (MDTs) are effective, with benefits including improved glycemic control (Maynard et al., 2017). Decrease in the occurrence of neuropathy, nephropathy, retinopathy, and cardiovascular disease complications (Iqbal et al., 2024). Decrease in amputations and recurring foot ulcers (Khan et al., 2021a).

Furthermore, the number of patients admitted to hospitals has declined Joret et al., (2019) with a significant decrease in average duration from referral to appointment (Lo et al., 2022). As per the American Diabetes Association, diabetes is a persistent medical condition that necessitates individuals with diabetes to make many everyday decisions about self-management and carry out complex care actions. Diabetes self-management education and support establish a foundation to assist individuals with diabetes in making informed decisions and participating in essential tasks. It has demonstrated the ability to improve health outcomes. A collaborative healthcare team can help to ensure that patients with type II diabetes receive both Diabetes Self-Management Education (DSME) and Diabetes Self-Management Support (DSMS) on a regular schedule (Powers et al., 2017).

The review highlights that developed countries adopt a multidisciplinary approach to manage Type 2 Diabetes Mellitus (T2DM) more widely than underdeveloped countries. This can be attributed to several factors, such as better healthcare resources O'Brien et al., (2003), advanced technologies that facilitate coordinated care, such as electronic health records and telemedicine platforms, helping teams to communicate and manage care more effectively Li and Zhong, (2019), health insurance models and greater emphasis on interdisciplinary education and training for healthcare providers (Ostermann et al., 2012). This observation is consistent with the findings, as most studies implementing collaborative care techniques involve countries such as Malaysia, China, England, various Middle Eastern nations, Australia, Canada, and the United States.

In contrast, underdeveloped countries including Pakistan, Nigeria, India, Bangladesh, Sri Lanka, and South Africa often encounter difficulties when attempting to implement a multidisciplinary collaborative care model. These typically include limited healthcare funding, resource constraints, and less-developed healthcare infrastructure. Furthermore, there could be a lack of well-trained healthcare workers, rigorous healthcare policies, and technical obstacles that hinder the efficient collaboration among various specialties (Hanlon et al., 2014; Iqbal et al., 2019). Moreover, a randomized controlled trial conducted in Brazil and a pilot study conducted in Lebanon have demonstrated the effectiveness of a collaborative pharmacist-physician care model in achieving successfully managing Type II Diabetes.

Similarly, a survey carried out in the United States has shown that implementation of a collaborative pharmacist-physician care model facilitated through practice agreements allowing pharmacists to prescribe medications, joint patient appointments for simultaneous evaluation and treatment planning, and individual pharmacist consultations with subsequent physician collaboration to develop patient-specific treatment plans contributed to an average reduction of 1.16% in HbA1c levels. Studies indicate that individuals diagnosed with Type II Diabetes Mellitus require a well-organized system of healthcare professionals, including physicians, pharmacists, nurse practitioners, and nutritionists, to address the current deficiencies in effectively managing the disease (Taggart et al., 2009). Based on the findings of this study, researchers observed that physicians, nurses, pharmacists, and nutritionists often lacked collaborative teamwork and efficient communication.

For example, in Iqbal et al., (2021a) study only pharmacist-led interventions were provided. However, a study conducted by Almutairi, (2015) analyzed challenges for the management of diabetes. Given the complexity of Type II Diabetes Mellitus, continuous care from healthcare experts is essential. Utilizing dietitians, pharmacists, social workers, nurses, and physicians would lead to enhanced patient outcomes and increased efficacy in managing Type II Diabetes Mellitus. Multidisciplinary healthcare teams can improve the effectiveness of diabetic therapy and management delivered by physicians which includes activities such as self-care education, monitoring, and preventing complications. The results of this systematic review, which includes studies from many regions across the globe, highlight the vital importance of using collaborative care strategies to significantly improve the management of Type II Diabetes Mellitus.

These findings underscore the importance of healthcare systems adopting these techniques to minimize the progression of complications associated with Type II Diabetes Mellitus. In the future, it is essential to prioritize the integration and development of multidisciplinary teams. These teams have a responsibility to deliver efficient and patient-centered care that effectively addresses the complex features of Type II Diabetes Mellitus and its treatment, which can be achieved by embracing the distinct attributes and skills possessed by each individual on the team.

5. CONCLUSION

The review highlights the advantages of utilizing team-based care to effectively manage Type II Diabetes Mellitus and its associated multiple complications, emphasizing the importance of a collaborative approach in healthcare. An examination of 20 studies revealed that a team of healthcare professionals—comprising of pharmacists, nurses, and dietitians—effectively reduced HbA1C levels and lowered the incidence of diabetes-related complications, including retinopathy, nephropathy, neuropathy, and cardiovascular issues. The interventions implemented by pharmacists, physicians, nurses, and other healthcare professionals addressed patients' lifestyle modification, adherence to prescription regimens, dietary changes, preventative measures, and dispensing guidance. The positive outcomes of this approach suggest that a broader dissemination across healthcare systems is necessary for treating Type II Diabetes Mellitus in patients.

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Ethical Approval

The present systematic review was undertaken with approval from the university's ethical review board, under the ethical process number ERB-PHRMD-DPP/9095-A.ct.

Authors' Contributions

This study was conducted collaboratively by all authors. The final manuscript was reviewed and approved by every author.

Informed Consent

Not Applicable

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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